LARGE POWER RATES

AN EXPLANATION FOR LAYMEN

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Energy Charges and Demand Charges

There are two principal elements in the cost of furnishing electric service:

(1) The quantity of Energy used by the consumer (in other words, kilowatt-hours).

(2) The consumer's peak load or Maximum Demand.

These terms may be illustrated by the following example:

Assume that a consumer has ten 100 watt lamps. His peak load or maximum demand will occur when all ten lamps are turned on and will be 1000 watts or one kilowatt.

If the ten lamps burn for one hour they will use one kilowatt-hour of energy. In ten hours they will use ten kilowatt-hours.

In general the consumer's maximum demand is the highest demand which he establishes during the period under consideration (usually a period of one month.)

The investment required to furnish service depends very largely on the consumer's maximum demand since this determines the size of the transformers, the capacity of lines and of generating equipment devoted to his service. Consequently maximum demand is fully as important a cost element as kilowatt-hours, but never-the-less rates to small consumers are generally based on kilowatt-hours alone for the sake of simplicity,

and because uninformed consumers object to demand charges.

Rates to large consumers nearly always include charges based on demand. By properly proportioning the charges for demand and energy it is possible to make electric bills approximate closely the cost of service, no matter whether kwh usage is large or small in comparison with demand. Then by adding lower priced blocks to allow for the economies incident to bulk sales, it is possible to obtain still closer approximation to the cost of service. For example, consider the following rate:

A Demand Charge of

$1.25 per kw per month for the first 100 kw of demand

$1.00 per kw per month for all in excess of 100 kw

Plus an Energy Charge

First 10,000 kwh used per month at 1.5¢ per kwh

Next 40,000 " " " " " 1.0¢ " "

Balance of " " " " " 0.8¢ " "

Under this rate the bill for 300 kw and 100,000 kwh would be:

$1.25 X 100 kw	$125
$1.00 X 200 kw	200
300 kw	
10,000 kwh X 1.5¢	150
40,000 kwh X 1.0¢	400
50,000 kwh X .8¢	400
100,000 kwh Total Bill	$1,275

Load Factor

Demand and Load Factor are closely related. Let us use the same illustration as before of ten 100 Watt lights which have a demand of one kilowatt and use one kilowatt-hour when burned for one hour. If these lights should burn continuously for an entire month, they will use 730 kilowatt-hours since this is the number of hours in a month of average length.

Such a continuous load is said to have a monthly load factor of 100 per cent. If the lights burn only one-half the time, they would use 365 kilowatt-hours per month and their monthly load factor would be 50 per cent.

Typical REA cooperatives have monthly load factors of 35 per cent to 50 per cent. The former load factor corresponds to 255 hours use of the maximum demand and the latter to 365 hours use of the maximum demand, both figures being based on a 730 hour month.

Rate Types

Rates containing a demand charge are therefore called load factor types of rate. There are two common types.

(1) a charge per kilowatt of demand, plus an energy charge. An example of this type of rate is given above under the heading Energy Charges and Demand Charges.

(2) rates which make use of the term "hours use of demand", for example:-

First 100 hours use per month of the maximum demand at 2.0¢ per kilowatt-hour
Next 100 " " " " " " " " " 1.0¢ " " "
Balance of kilowatt-hours used per month " 0.5¢ " " "

Under this rate the bill for a demand of 300 kw and a usage of 100,000 kwh would be computed as follows:-

First determine the number of kwh corresponding to 100 hours use of the demand. For 300 kw this will be 300 X 100 = 30,000 kwh

Bill:

30,000	kwh	X 2¢		$600
30,000	"	X 1¢		300
40,000	"	X .5¢		200
100,000	"		Total Bill	$ 1100

The bill for 250 kw and 100,000 kwh under the same rate would be computed as follows:-

100 hours use of demand is

250 X 100 = 25,000 kwh

Bill:

25,000 kwh	X 2¢	$500
25,000 "	X 1¢	250
50,000 "	X .5¢	250
100,000 "		$1000

The terms "hours use of the demand" and "kwh per kw of demand" mean the same thing. Thus the foregoing rate could have been expressed as follows:

First 100 kwh per kw of demand @ 2.0¢ per kwh

Next 100 " " " " " @ 1.0¢ " "

All over 200 " " " " " @ 0.5¢ " "

Charges per kwh and per kw are the basic elements of nearly all rates. They are used in various combinations as for example in the following rate which appears complicated but is composed of the same basic elements:

A Demand Charge of:

$1.00 per kw of demand

Plus Energy Charges of:-

First 100 kwh per kw of demand:

1.0¢ per kwh for the first 50,000 kwh

.8¢ per kwh for all over 50,000 kwh

Next 100 kwh per kw of demand:

.7¢ per kwh for the first 100,000 kwh

.6¢ per kwh for all over 100,000 kwh

For all over 200 kwh per kw of demand:

.5¢ per kwh

On the above rate a consumer having a demand of 2000 kw and using 700,000 kwh would be billed as follows:

First determine the number of kwh included in the "first 100 kwh per kw of demand". Since the demand in this case is 2000 kw the number of kwh included is 2000 times 100 or 200,000 kwh. Therefore 200,000 kwh will be billed under the "First 100 kwh per kw of demand" and another 200,000 kwh will be billed under "Next 100 kwh per kw of demand". The remaining 300,000 kwh will be billed under the final block at .5¢ per kwh.

Bill

Demand Charge 2000 X $1.00		$2,000
Engergy Charges:		
First 100 kwh per kw		
50,000 kwh @	1.0¢	500
150,000 kwh @	.8¢	1,200
Next 100 kwh per kw		
100,000 kwh @	.7¢	700
100,000 kwh @	.6¢	600
Over 200 kwh per kw		
300,000 kwh @	.5¢	1,500
700,000 kwh	Total Bill	$6,500

Power Factor and Kilovolt-Ampere Demand

Maximum demand is often measured in kva instead of kw. Kva is the abbreviation for Kilovolt-Amperes (The product of Kilovolts times Amperes). One Kilovolt is 1000 volts. Kva and kw are identical if the power factor is 100 percent, but in general power factor is less than 100 percent and kva demand is greater than kw demand.

The relation between kw, kva and Power Factor is expressed by the formula:

kw = kva X % Power Factor

Thus, if the power factor is 80 percent and the demand in kva is 500, the demand in kw will be: -

kw = 500 X .80 = 400

It is difficult to define power factor for the layman. However for our present purpose, it may be sufficient to say that low power factor is caused by currents larger than those usefully employed in producing power. These wasteful amperes are usually caused by motors, particularly motors operating at light load. They are also caused by electric welders, neon lights and many other devices. Lightly loaded transformers contribute to poor power factor. In both meters and transformers a certain amount of current is required to magnetize their iron cores and these magnetizing currents cause low power factor.

The cost of electric service is proportional to kva demand rather than kw demand because the capacity of generators, transformers and lines are all proportional to kva rather than kw.

From the point of view of the supplier it is best to measure maximum demand in kva rather than kw because this reflects the cost of service more accurately. However, it is only in recent years that satisfactory meters have been available at reasonable cost to measure demand in kva. Therefore, most wholesale rate schedules are based on kw demand, but they usually contain a clause permitting the supplier to measure power factor if he finds it advisable and adjust the demand charge for low power factor.

A power factor of 80 to 85 percent is generally considered normal. Many rates make no adjustment unless power factor is less than 80 percent. Other rate schedules base the demand charge on a given power factor such as 85 percent and call for an adjustment in the demand charge upward or downward in proportion to the variation from 85 percent power factor. Since REA systems generally have power factors ranging from 85 percent to 100 percent, it is important for them to obtain credit for high power factor.

Measurement of Maximum Demand

Demand meters are designed to measure the average demand during a specified period of time, such as 15 minutes or 30 minutes. A recording 15 minute demand meter for example, registers the demand on a chart or tape every 15 minutes. At the end of the month the chart or tape is inspected and the maximum demand for the month is selected. This maximum demand is the demand used in the bill for that month. An indicating demand meter has a pointer on the meter dial which indicates the highest demand established during the month. When the meter is read at the end of the month the pointer is set back to zero. The date and hour when the maximum demand occurred is shown by a recording meter, but not by an indicating meter.

It will be obvious that the maximum 15 minute demand will be higher than the 30 minute demand if the load is not constant. Instantaneous peaks would be still higher. On typical REA systems the maximum 15 minute demand is about 2 or 3 percent higher than the 30 minute demand. Nearly all wholesale rates to cooperatives specify either 15 or 30 minute demands.

Demand Ratchet

Some contracts contain a provision such as the following:

> "The demand for billing purposes shall not be less than 60 percent of the highest demand occurring during the preceding eleven months."

This type of provision is called a ratchet. If the maximum demand in any month falls below 60 percent of the highest demand established in any of the preceding eleven months, the provision results in a "ratchet" charge for that month.

Fuel Adjustment and Tax Adjustment

Many rate schedules contain a fuel adjustment clause which adjusts the rate to cover increases or decreases in the cost of fuel. Such adjustments in the bill should not exceed the actual increase in the cost of fuel and should give a corresponding credit to the consumer when the cost of fuel decreases.

Tax adjustment clauses are designed to protect the supplier against possible increase in taxes. The tax adjustment should be limited to direct taxes which can be allocated in proportion to the quantity of power and energy sold. Such taxes as income taxes should not be included.

Billing Demand

After the metered demand has been adjusted for power factor or whatever other adjustment may be called for by the provisions of the rate schedule the adjusted demand to be used for billing purposes is called the billing demand. The words "billing demand" are often used in the rate itself in place of "maximum demand."

Combined Billing

Combined billing for several delivery points is not generally permissible. Rate schedules nearly always contain a provision that the rate shall be applied separately at each delivery point. REA cooperatives will generally find that the most satisfactory type of wholesale rate is one where the charges are based entirely on load factor and are independent of the quantity used. With this type of rate there is very little to be gained from combined billing. However, the cooperative can obtain the advantage of numerous delivery points at little or no sacrifice in rate level.

Contract Demand

The term, "contract demand" generally means the maximum demand which the power supplier agrees to furnish. In some contracts the supplier agrees to supply the entire requirements of the consumer without any maximum limit, but in others the supplier agrees to supply the consumer's requirements up to a certain maximum figure which is the contract demand. Occasionally the term "contract demand" is used to mean the minimum demand for which the consumer is billed, whether or not it is actually used during that month. In reviewing a contract, care should be taken to see that the supplier agrees to supply as much capacity as the consumer needs and also that the minimum contract demand which the consumer agrees to pay for, whether he uses it or not, is not burdensome.